NPS-AM-08-032

EXCERPT FROM THE

PROCEEDINGS

OF THE

FIFTH ANNUAL ACQUISITION RESEARCH SYMPOSIUM

STRIKER SUITABILITY CHALLENGES IN A COMPLEX THREAT ENVIRONMENT

Published: 23 April 2008

by

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5th Annual Acquisition Research Symposium of the Naval Postgraduate School:

Acquisition Research: Creating Synergy for Informed Change

May 14-15, 2008

Prepared for: Naval Postgraduate School, Monterey, California 93943

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **23 APR 2008**	2. REPORT TYPE	3. DATES COVERED **00-00-2008 to 00-00-2008**
4. TITLE AND SUBTITLE **Striker Suitability Challenges in a Complex Threat Environment**		5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)		5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Defense Acquisition University,9820 Belvoir Road,Fort Belvoir,VA,22060-5565**		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S REPORT NUMBER(S)
12. DISTRIBUTION/AVAILABILITY STATEMENT **Approved for public release; distribution unlimited**		
13. SUPPLEMENTARY NOTES **5th Annual Acquisition Research Symposium: Creating Synergy for Informed Change, May 14-15, 2008 in Monterey, CA**		
14. ABSTRACT		
15. SUBJECT TERMS		

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**79**	

The research presented at the symposium was supported by the Acquisition Chair of the Graduate School of Business & Public Policy at the Naval Postgraduate School.

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Striker Suitability Challenges in a Complex Threat Environment

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Abstract

The cost of operating and maintaining weapon systems is a large expense to the Department of Defense (DoD), and suitability performance is a major factor affecting these costs. Systems with poor suitability performance (such as low reliability, high failure rates, high spare parts usage, and low availability) are extremely difficult to support in a constrained resource environment. For many DoD acquisition programs, suitability lags effectiveness during program development. Suitability determinants (such as reliability and maintainability) are generally not addressed early enough during program development (prior to fielding) and are not prioritized with the same vigor and discipline as performance parameters like speed, accuracy, and lethality. The JROC, DOT&E, and USD(AT&L) have each called for increased attention to suitability improvement.

Introduction

The primary purpose of this article was to investigate the suitability performance challenges of the recently deployed Stryker system, which was accelerated into combat in 2003. Suitability drivers were identified and possible causal factors were investigated. Several specific suitability issues for the Stryker system were revealed during this study. Stryker is performing well in the field with an Operational Readiness Rate (ORR) consistently above the required contractual value. However, a harsh combat scenario, dynamic threat environment, and extremely high tempo of operations have created unique challenges to operators and maintainers.

Background

During his first annual report to Congress, the newly confirmed Director of Operational Test and Evaluation (DOT&E) Dr. Charles E. McQueary made three initial observations. His first observation was that Operational Test & Evaluation (OT&E) is too often the place where performance deficiencies are discovered. Finding performance problems early in the Department of Defense (DoD) acquisition process is important—either in government Developmental Test & Evaluation (DT&E) or contractor testing. Detecting and correcting design issues early in the development process will mitigate program cost overruns and schedule delays. McQueary's second observation was that the DoD acquisition system is inherently slow and must improve to accommodate rapid fielding of new weapons systems and new technologies. The need for rapid fielding of new technology is evident in the extended hostilities in Iraq and Afghanistan (e.g., armor upgrades for the High Mobility Multipurpose Wheeled Vehicle (HMMWV) and the new Mine Resistant Ambush Protected (MRAP) vehicle). His third observation was that operational suitability of DoD systems is too low and needs to improve. The definition of operational suitability, which can be found in the *Defense Acquisition Guidebook*, Chapter 9 (Operational Test and Evaluation), Section 9.4.5 (Evaluation of Operational Suitability), is as follows:

> Operational Suitability is the degree to which a system can be satisfactorily placed in field use, with consideration given to reliability, availability, compatibility, transportability, interoperability, wartime usage rates, maintainability, safety, human factors, manpower supportability, logistics supportability, documentation, training requirements, and natural environmental effects and impacts. (Duma & Krieg, 2005)

The Cost of Low Suitability

Low suitability is a direct contributor to higher lifecycle support costs. Data for the previous three years (2004–2006) showed that 35% of Initial Operational Test & Evaluation (IOT&E) phases resulted in unfavorable suitability evaluations as reported to Congress in each system's Beyond Low Rate Initial Production (BLRIP) Report (Director, Operational Test and Evaluation, 2007).

While the technical performance of weapon systems (such as speed, accuracy, and firepower) has improved significantly over the last several decades, suitability parameters (such as reliability, availability, and maintainability) have not improved. Figures 1, 2, and 3 indicate that this problem has been a trend for more than 20 years. All data in Figures 1–3 are based on Army Test and Evaluation Command (ATEC) programs evaluated during the years shown. Figure 1 (Duma & Krieg, 2005) shows that from 1985 through 1990, only 41% of programs evaluated by ATEC successfully demonstrated reliability requirements during operational testing. Figure 2 (Duma & Krieg, 2005) shows that between 1996 and 2000, only 20% of programs met reliability requirements; and Figure 3 (US Army Test and Evaluation Command, 2007) shows that from 1996–2005, only 34% of programs met reliability requirements.

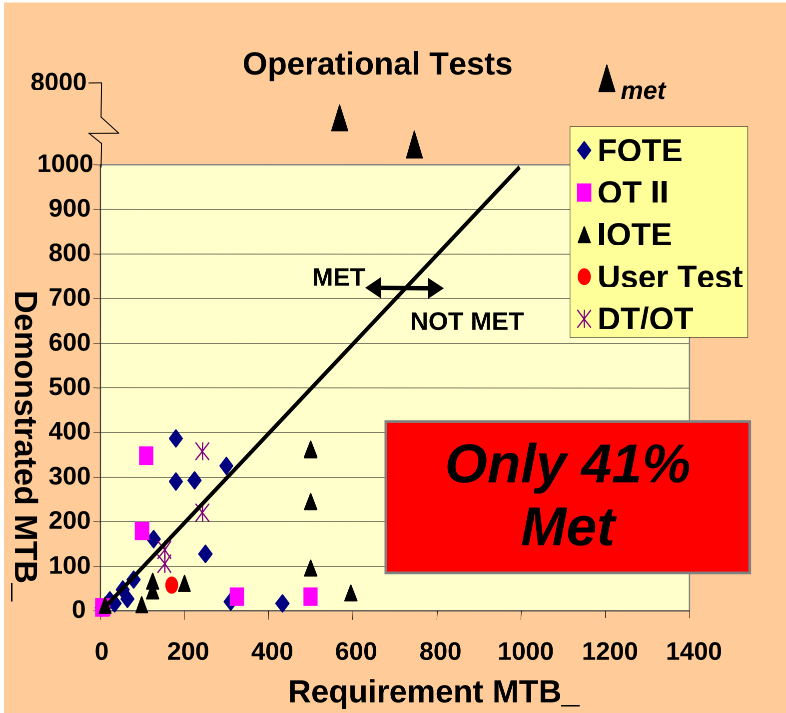

Figure 1. Reliability During Operational Tests (1985–1990)
(Duma & Krieg, 2005)

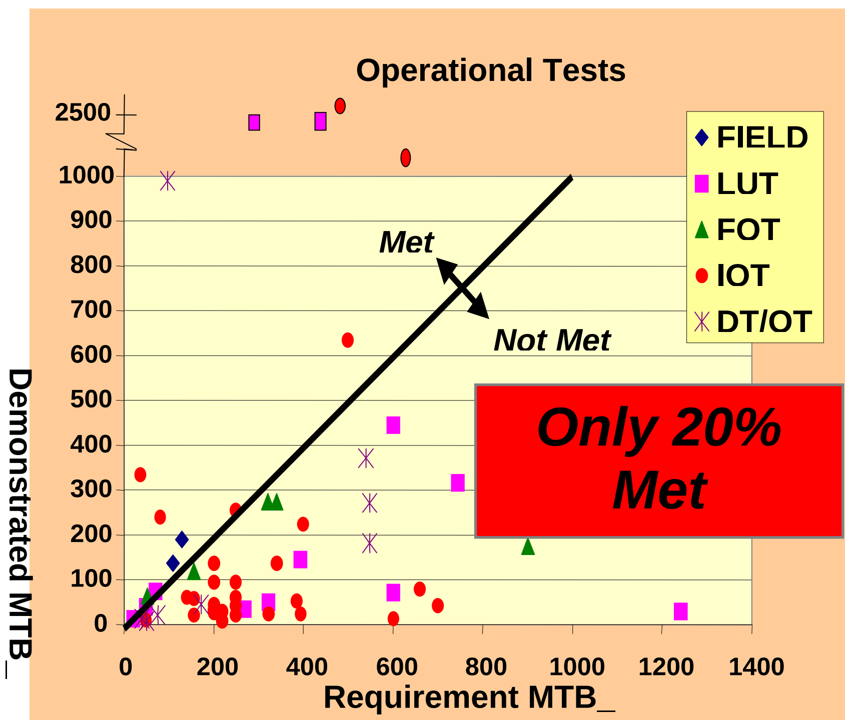

Figure 2. Reliability During Operational Tests (1996–2000)
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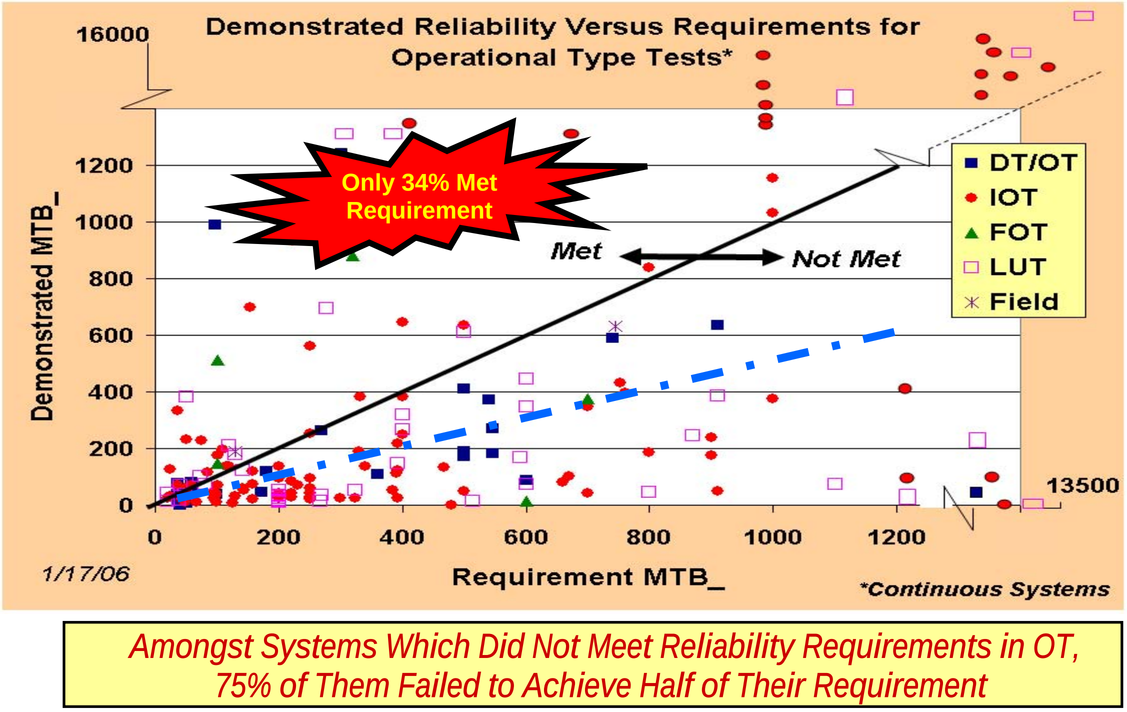

Figure 3. Reliability During Operational Tests (1996–2005)
(US Army Test and Evaluation Command, 2007)

Stryker was a new Army program in 2000, but suitability issues were certainly not a new problem. The Defense Science Board (DSB) pointed out in 2000 that 80% of US Army defense systems fail to achieve even half of their required reliability parameters (National Research Council, 2006). Steps have been taken to help address this concern. In November 2004, the Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)), directed that acquisition programs measure performance in terms of operational availability, mission reliability, and cost per unit of usage (USD(AT&L), 2004). Three months later, the USD(AT&L) issued a memorandum on Total Life Cycle Systems Management (TLCSM) Metrics, which provided specific definitions, formulas, and metrics for calculating important suitability parameters, such as operational availability and mission reliability. In 2005, the DSB recommended that the DoD aggressively pursue implementation of performance-based logistics for all weapon systems. The USD(AT&L) has also directed that the TLCSM Executive Council develop a metrics handbook to be used in performance-based contracts and sustainment oversight (USD(AT&L), 2004; 2006). In August 2006, the Joint Requirements Oversight Council (JROC) mandated a Key Performance Parameter (KPP) of *materiel availability* including key system attributes of *materiel reliability* and *ownership costs* (Joint Requirements Oversight Council, 2006). These initiatives were designed to improve operational performance, establish standard suitability metrics, and reduce lifecycle support costs of new DoD weapon systems.

McQueary's third observation in his FY 2006 Annual Report is the basis for this research article. Many times, systems receiving favorable effectiveness evaluations but unfavorable suitability evaluations from IOT&E are fielded before suitability shortcomings are corrected. Even though there may be good reasons for deploying these systems before correcting all suitability issues (such as an urgent combat need or the negative consequences of stopping a hot production line), fielding systems before suitability deficiencies are corrected will result in reduced operational availability and increased support costs. Low suitability directly results in increased lifecycle support costs. These costs can appear in many forms, such as increased spares, increased contractor support, increased maintenance actions, increased maintenance man-hours, decreased reliability, decreased availability, and decreased combat capability. Costs over and above the planned costs of lifecycle support can represent a large and unbudgeted expense for the DoD. This undesirable trend of low suitability during major weapon system development has been observed for at least 20 years across all services, and this trend is not improving. For example, the reliability success rate of Army systems tested in 1996–2005 (34%) is lower than the reliability success rate for 1985-1990 (41%).

Overview

The Stryker family of vehicles was conceived as part of the Army’s Transformation Campaign Plan. In 1999, General Eric Shinseki, the Army Chief of Staff, came to the conclusion that the Army had serious deployability and mobility issues (Military.com, 2007). Though the Army was capable of full-spectrum dominance, its organization and force structure were not optimized for strategic responsiveness. Army light forces could deploy rapidly, but they lacked the lethality, mobility, and staying power necessary to be effective in peacekeeping scenarios. On the other hand, Army mechanized forces possessed the necessary lethality and staying power but required a large logistics footprint, which hindered their ability to be quickly deployed.

Subsequently, the Secretary of the Army announced a new Army vision in October 1999 to build a landpower force capable of strategic dominance across the full spectrum of ground combat operations. The key to implementing this vision was that the Army become more strategically responsive. Stryker was designed as a full-spectrum, early-entry combat force and optimized primarily for employment in small-scale contingencies. It was developed to operate in a complex environment, including urban terrain, while confronting low- to mid-range threats with conventional and asymmetric capabilities. Requirements for the Stryker include rapid deployment, early entry execution, and the ability to conduct effective combat operations immediately upon arrival (Training and Doctrine Command, 2000, June 30).

Schedule-driven Compromises

Stryker was initially deployed to Iraq in 2003 due to an urgent combat requirement. Prior to deployment, Stryker underwent an aggressive and accelerated development and test program. The urgency of the war prevented the complete spectrum of operational testing to be completed within allowable time constraints. During IOT&E, only a few selected missions, types of terrain, and levels of conflict intensity were evaluated. Also, vehicles used did not accrue sufficient operating time to yield statistically relevant Reliability and Maintainability (R&M) data. In addition, a major configuration change was not included as part of IOT&E or PVT (Production Verification Tests) because add-on armor was not available for installation when testing was performed. The add-on armor package increased vehicle weight by approximately 20%. Since these tests were done in under-stressed conditions (without add-on armor), long-term durability problems were unlikely to be detected (National Research Council, 2004).

Schedule-driven compromises in T&E are not unusual to DoD programs.

> Pressures on program officials to meet budgets and deadlines, due to congressional and other oversight, result in test strategies geared toward demonstrating “successful” performance. Thus, testing is often carried out under benign or typical stresses and operating conditions, rather than striving to

determine failure modes and system limitations under more extreme circumstances. (National Research Council, 2006, p. 19)

According to an article printed in the *Detroit News* (Zagaroli, 2005), the Project on Government Oversight, a nonprofit government accountability organization, reported that Stryker was rushed through development, and lack of complete testing could give operators a false sense of security if failure modes are not understood (2005). However, the same newspaper article acknowledged that reports from the field overwhelmingly indicated that Stryker was performing in an outstanding manner. One of the early decisions made by the Army to support an accelerated development and deployment timeline was to rely on contractor performance-based logistics (PBL) support within the Stryker brigades. Some of the duties of the contractor personnel included conducting maintenance on the Stryker vehicle and managing the Stryker-specific supply chain. When Stryker was first deployed to Iraq, the Army did not have the institutional capability to train soldiers on conducting Stryker vehicle maintenance, and therefore faced an immediate need for contractor maintenance personnel to support the deployment (GAO, 2006, September 5).

Each deployed Stryker brigade was fielded with 45 imbedded vehicle maintenance contractor personnel. The Army desires to eventually replace the 45 contractors with active duty soldiers. Current plans call for implementation (removal of embedded contractors) to begin in 2008; however, the GAO reported that this goal will be difficult for the Army to achieve for several reasons. First, the 45 imbedded contractor maintenance personnel must be replaced by 71 soldiers due to other collateral duties and common training requirements of soldiers. Second, the Army is very short of personnel with the five military occupational specialties for wheeled vehicle mechanics—resulting in a very difficult recruiting challenge for the Army. Currently, as reported by the *Washington Post* (White, 2007) and the *New York Times* (Cloud, 2007), the Army is falling short of current recruiting goals.

Operational Readiness

A key factor affecting Stryker suitability performance is deployed operational tempo (OPTEMPO). The program office estimates that the operational tempo is 6 times greater than the originally planned OPTEMPO. Other interviews yielded estimates of operational tempo up to 10 times the planned OPTEMPO. Harry Levins (2007) reports that vehicles in Iraq are using up 7 years of service life for each year of service in Iraq. The Government Accountability Office (GAO, 2006, September 5) estimates that service life is being expended 800% faster than expected. This greatly increased operational tempo results in unexpected failure modes and increased failure rates.

A general finding of this study was that the Army is satisfied with Stryker's performance in the field. System performance in an asymmetric combat scenario under difficult environmental conditions exceeds Army expectations. Brigade commanders have consistently reported high operational readiness rates (greater than 90%) since Stryker was fielded, despite the fact that combat conditions in Iraq have been much different than expected (Figure 4). For example, from October 2003 to September 2005, the first two Stryker brigades that deployed to Iraq reported an average Operational Readiness Rate (ORR) of 96%, which was well above the Army-established ORR performance goal of 90%.

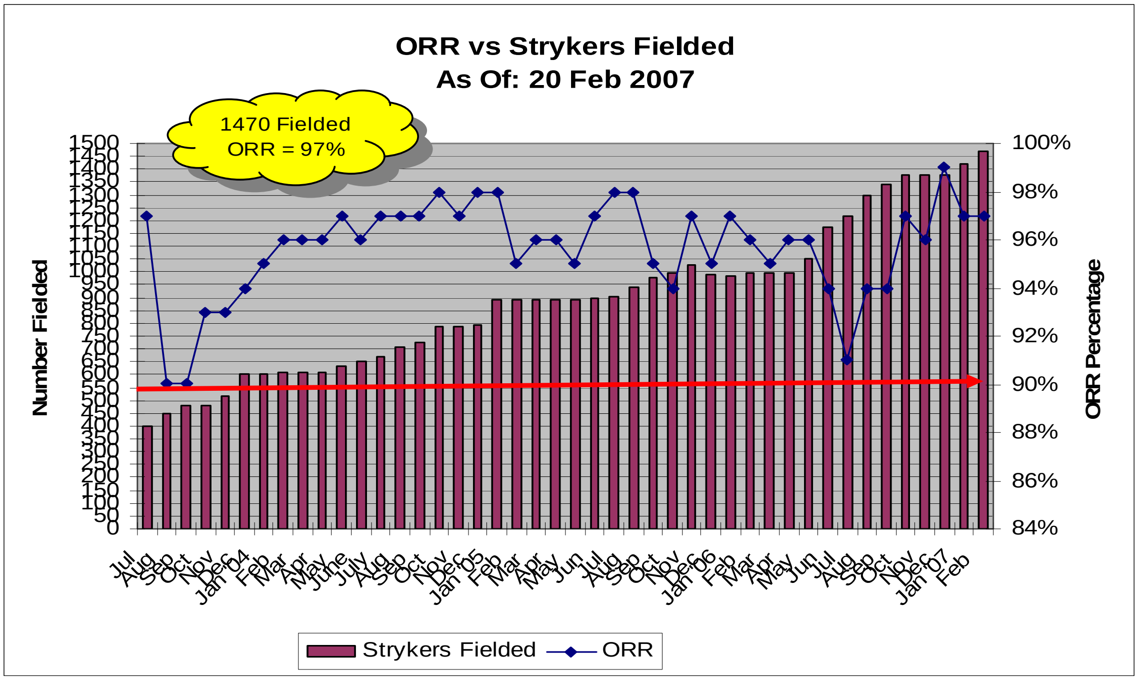

Figure 4. Operational Readiness Rates

Due to the asymmetric nature of the threat forces and to the highly adaptive nature of the enemy, the combat scenarios and operating environment have been much different than expected. According to the Stryker Interim Armored Vehicle Operational Mode Summary/Mission Profile (IAV OMS/MP) (Training and Doctrine Command, 2000), the Stryker planned mission profile called for operations on hard roads 20% of the time, and cross-country operations 80% of the time. The actual Stryker usage in Iraq has been almost the opposite (~ 80% on hard roads, 20% cross-country). Most missions resemble police actions in an urban environment on paved roads, and crews must routinely drive over curbs and other small obstacles to navigate the urban environment. This requires a higher tire pressure than normal, causing more vibration and shock loads and high structural stress on the vehicles.

In response to the greater threat of rocket propelled grenades (RPGs), improvised explosive devices (IEDs), and small projectiles, the Army configured Stryker with an add-on slat armor package and crews added sand bags. The additional weight affected the performance of the Stryker family of vehicles as follows:

- To operate with the increased vehicle weight, the operating tire pressure had to be increased from the design specification of 80 psi to 95 psi. Stryker is configured with a centralized tire pressure system that is designed to automatically keep the tire pressure at the optimum value for specific terrain conditions, speed, and traction. The automatic inflation system was not designed to maintain 95 psi, so soldiers must set tire pressure manually and check it three times daily (Smith, 2005). The requirement to over-inflate the tires to 95 psi and to physically check tire pressure three times per day is an operational nuisance because these are unplanned, but necessary, preventive maintenance actions. Additionally, the combination of routine excessive structural stress and increased tire pressure causes unanticipated structural failures. For example, a large number of wheel spindles developed fatigue cracks and had to be replaced early. Drive shafts are also failing sooner than expected.

- Due to the issues of added weight, excessive tire pressure, and severe operating conditions, tires are also failing at a high rate. In one 96-hour test period at Fort Irwin, CA—with 16 Stryker vehicles—13 tires had to be changed (*WorldNetDaily*, 2003). The *Washington Post* reported that 11 tire and wheel assemblies fail every day, and the GAO asserts that each Stryker vehicle is going through one tire per day on average (Smith, 2005). The additional maintenance actions (checking/adjusting tire pressures and changing tires) are extremely burdensome to the crews since changing tires is not crew-level maintenance and requires special tools.
- The 5,000 pounds of armor to counter RPG threats is generally effective but has many negative operational consequences, such as limited maneuverability, increased component stresses, safety issues, and transportability issues. The extra weight and increased physical dimensions caused by the add-on slat armor adversely impacts performance, especially when maneuvering in spaces with narrow clearance and maneuvering in wet conditions. Operations in soft sand or wet conditions (mud) place additional stress on engines, drive shafts, and differentials; these items have experienced higher-than-normal failure rates (Dougherty, 2004).
- Also, the slat armor causes multiple problems for safe and effective operations. Slat armor can deform during normal operations, sometimes blocking escape hatches and the rear troop egress door. The armor adds approximately 3 feet to the vehicle’s width and can interfere with the driver’s vision. Armor also makes it difficult for others to see the Stryker at night, which is a safety hazard in the urban environment. The armor is very heavy for the rear ramp and strains lifting equipment; crews must sometimes manually assist raising or lowering the rear ramp. The armor attaching bolts on the rear ramp can break off with normal use (increasing the maintenance burden) and may generate unsafe conditions. In addition, slat armor prohibits normal use of storage racks, which may impact operations. Lastly, slat armor affects the transportability of the vehicle in a C-130 cargo aircraft, since the extra weight greatly reduces transport range (GAO, 2004).

Even though these operational issues caused by the add-on slat armor place additional maintenance burdens on crews, Stryker has been reported to be well-suited for the urban fight. Unlike the M-1 tank, Stryker can operate very quietly at high speed, which can be a tremendous tactical advantage (Tyson, 2003). Most Army personnel interviewed felt strongly that Stryker’s tactical performance in the urban environment in Iraq was significantly better than the M113A3, HMMWV, Bradley Fighting Vehicle, or Abrams Tank.

In response to unanticipated urgent combat needs in Iraq, some engineering improvements (configuration changes) were performed on the Stryker since deployment. Since the Army did not buy the technical data package because of its cost, these engineering changes have resulted in increased costs and potential risks (GAO, 2006, July). The GAO reports that current DoD acquisition policies do not specifically address long-term technical data rights for weapon system sustainment. As part of the department’s acquisition reforms and performance-based strategies, the DoD has de-emphasized the acquisition of technical data rights. The GAO has recommended that the DoD recognize the need for the acquisition of technical data rights and asserts that without technical data rights, the DoD may face challenges in efficiently sustaining weapon systems throughout their lifecycle.

A very important contractual requirement for the prime contractor, General Dynamics Land Systems (GDLS), is to maintain an Operational Readiness Rate (ORR) of 90% or better. This requirement pertains only to the base vehicle configuration and does not include Government Furnished Equipment (GFE). Since initial deployment, Stryker has routinely exceeded this operational requirement. The Cost Plus Fixed Fee (CPFF) contract effectively motivates GDLS to exceed 90% ORR; however, the contract is not necessarily effective at controlling support costs, and this may be a risk to the government (US Army Audit Agency, 2005). One example of such a risk is the repair and replacement of a high-failure item—for example, cracked hydraulic reservoirs in the power pack. Maintenance procedures call for the entire power pack to be replaced as a unit, rather than removing and repairing/replacing the hydraulic reservoir within the power pack. Replacing entire power packs (instead of repairing/replacing hydraulic reservoirs within the power packs) results in shorter down-times and higher ORR, but it also requires more power packs (very large, expensive units) to be purchased and shipped to operating bases and forward maintenance facilities. The net result is that higher operational readiness is being purchased with increased transportation and storage costs.

Sustainability Challenges

Since Stryker's initial deployment was accelerated to meet an urgent combat need, the Stryker program team was performing the following activities concurrently: testing, production, fielding, training, and combat. In addition to the many challenges caused by these concurrent activities, the threat and operational environment in Iraq were different than anticipated, as previously mentioned. Several other factors added to the difficulty of maintaining Stryker vehicles in the field.

First, the Interactive Electronic Technical Manuals (IETMs) were not mature at the time of initial fielding. Many maintenance procedures could not be performed based on the IETMs because they were either not characterized correctly or crews were not adequately trained on their use. This situation led to *tribal system maintenance*, in which units depended on soldiers and contractors with experience on similar systems (like the M-113 armored personnel carrier) to figure out how to perform the maintenance actions correctly.

Second, since a large portion of maintenance actions were supported by contractor personnel, soldiers developed a *rental car mentality*. This lack of *ownership mentality* resulted in soldiers being overly dependent on contractor personnel to perform routine preventive maintenance actions, such as checking fluid levels. One vehicle was lost because the pre-mission engine oil check was ignored.

Findings

Stryker is performing well in the field. The system is exceeding expectations of Army management and soldiers. In spite of a changing threat environment (improved IEDs and excessive operations in the urban environment) and major configuration changes (5,000 pounds of add-on armor), Stryker is accomplishing its mission. The Operational Readiness Rate has consistently been over 90%.

Due to the increased threat of RPGs and IEDs, Stryker was outfitted with an add-on armor package. The additional 5,000 pounds of armor has been generally effective at mitigating the threat but has resulted in some negative operational/support consequences. The extra weight requires increased tire pressure, which causes operational problems and more structural stresses. Additionally, the armor limits crew visibility during operations and restricts airlift transportability on a C-130 aircraft.

Army decisions regarding contractor logistics support may remain with the Stryker program for years. When Stryker was first deployed to Iraq in 2003, the Army faced an immediate need for contractor maintenance personnel to support operations (45 vehicle maintenance personnel per brigade). The Army plans to eventually replace the 45 contractor maintenance personnel with soldiers, but it will take approximately 71 soldiers per brigade to perform the same level of vehicle maintenance as the 45 contractors because of other duties and responsibilities of active duty personnel. The current plan is to begin the transition to soldier maintenance in 2008, but the transition will probably be very difficult to implement due to the poor recruiting/retention outlook in general and to the shortage of appropriate active duty maintenance personnel.

Stryker program development was accelerated to meet the Army's combat needs in Operation Iraqi Freedom. Due to the compressed developmental schedule, Stryker DT/OT was unable to fully test all configuration changes. DT revealed relevant problem areas, but there was insufficient time or priority to correct all problems before OT and fielding.

For many DoD acquisition programs, the maturity of suitability parameters lags the maturity of effectiveness parameters during program development. Suitability determinants (such as reliability and maintainability) are not addressed early enough and are not prioritized with the same vigor and discipline as performance parameters like speed, accuracy, and lethality.

The general issue of suitability shortfalls in DoD acquisition programs is recognized at high levels of management and is being addressed. JROC, DOT&E, and USD(AT&L) have each called for increased attention to suitability improvements. For example, a new requirement exists for a Materiel Availability KPP.

The operational tempo of Stryker vehicles in Iraq far exceeds original usage estimates by at least 500%. Also, the mission profile of Stryker is much different than expected (80% on paved roads). This, in combination with the added weight of slat armor, has resulted in excessive stresses to the suspension, wheels, and tire assemblies, which causes increased failure rates of these items.

Since Stryker was fielded in 2003 in Iraq, the operational situation has been dynamic, unpredictable, and volatile. Four factors have made it very difficult to obtain complete and reliable data for trend analyses. The first factor is the rapidly evolving adaptive nature of the threat in an asymmetric combat environment. The second factor is that the operational environment for deployed Stryker vehicles is more severe than anticipated during design/development. The third factor is that, in response to the first two factors, configuration changes have precluded a stable baseline. The fourth factor is that in a dangerous combat scenario, recording and reporting data is not a high priority for operational crews.

Conclusions

In response to Operation Iraqi Freedom, there was an urgent operational need to deploy the Stryker system. Therefore, the development and test programs were greatly accelerated to get Stryker units into the field as quickly as possible. At the same time, the mission was changing as the threat quickly adapted and evolved in this asymmetric combat environment.

The continually changing configuration baseline and changing tactical conditions made it very difficult to evaluate or predict reliability and suitability performance across all mission scenarios. The operational situation has been dynamic, as well as unpredictable and volatile, because Stryker was deployed in operational combat conditions that were different from, and much more complex than, those originally anticipated. In many ways, the system was not adequately designed for the actual threat it currently faces. However, this is certainly not the first time nor the last time this type of situation will occur. As a result, this case is a good example of how incomplete or incorrect maintenance/support planning can significantly add to the logistics burden. Due to the adaptive nature of the threat in the asymmetric warfare environment of Iraq and Afghanistan, our acquisition managers and operational planners are challenged to consider more complex and dynamic combat scenarios and contingencies than ever before.

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2003 - 2008 Sponsored Research Topics

Acquisition Management

- Software Requirements for OA
- Managing Services Supply Chain
- Acquiring Combat Capability via Public-Private Partnerships (PPPs)
- Knowledge Value Added (KVA) + Real Options (RO) Applied to Shipyard Planning Processes
- Portfolio Optimization via KVA + RO
- MOSA Contracting Implications
- Strategy for Defense Acquisition Research
- Spiral Development
- BCA: Contractor vs. Organic Growth

Contract Management

- USAF IT Commodity Council
- Contractors in 21st Century Combat Zone
- Joint Contingency Contracting
- Navy Contract Writing Guide
- Commodity Sourcing Strategies
- Past Performance in Source Selection
- USMC Contingency Contracting
- Transforming DoD Contract Closeout
- Model for Optimizing Contingency Contracting Planning and Execution

Financial Management

- PPPs and Government Financing
- Energy Saving Contracts/DoD Mobile Assets
- Capital Budgeting for DoD
- Financing DoD Budget via PPPs
- ROI of Information Warfare Systems
- Acquisitions via leasing: MPS case
- Special Termination Liability in MDAPs

Human Resources

- Learning Management Systems
- Tuition Assistance
- Retention
- Indefinite Reenlistment
- Individual Augmentation

Logistics Management

- R-TOC Aegis Microwave Power Tubes
- Privatization-NOSL/NAWCI
- Army LOG MOD
- PBL (4)
- Contractors Supporting Military Operations
- RFID (4)
- Strategic Sourcing
- ASDS Product Support Analysis
- Analysis of LAV Depot Maintenance
- Diffusion/Variability on Vendor Performance Evaluation
- Optimizing CIWS Lifecycle Support (LCS)

Program Management

- Building Collaborative Capacity
- Knowledge, Responsibilities and Decision Rights in MDAPs
- KVA Applied to Aegis and SSDS
- Business Process Reengineering (BPR) for LCS Mission Module Acquisition
- Terminating Your Own Program
- Collaborative IT Tools Leveraging Competence

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STRYKER SUITABILITY CHALLENGES IN A COMPLEX THREAT ENVIRONMENT

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BACKGROUND

T&E Review

Operational Testing:

Effectiveness

Suitability

A_o (Operational Availability)

BACKGROUND

Operational Effectiveness:

Does it work ?

Operational Suitability:

Can we keep it working ?

BACKGROUND

Operational Suitability:

Can we keep it working ?

Major Drivers:

- **Reliability**
- **Repairability**
- **Spare Parts**
- **Test Equipment**
- **Trained Technicians**
- **Transportation & Storage**

BACKGROUND

Operational Availability (A_o):

Is it there when we need it ?

BACKGROUND

Operational Suitability is a major determinant of A_o.

A_o = UPTIME/(UPTIME + DOWNTIME)

Suitability . . . at what cost?

Typical IOT&E Evaluation Results:

EFFECTIVENESS: approximately _____ success rate
SUITABILITY: approximately ______ success rate

Suitability . . . at what cost?

Typical IOT&E Evaluation Results:

EFFECTIVENESS: approximately 90% success rate

SUITABILITY: approximately _____ success rate

Suitability . . . at what cost?

Typical IOT&E Evaluation Results:

EFFECTIVENESS: approximately 90% success rate

SUITABILITY: approximately 60 - 75% success rate

Suitability . . . at what cost?

Typical IOT&E Evaluation Results:

EFFECTIVENESS: approximately 90% success rate

SUITABILITY: approximately 60 - 75% success rate

Typical Decision after IOT&E: Begin fielding ASAP, even before . . . .

Suitability problems are addressed

Reliability is improved

Maintenance procedures are mature

Training is complete

. . . .

. . . .

Suitability . . . at what cost?

Typical IOT&E Evaluation Results:

EFFECTIVENESS: approximately 90% success rate

SUITABILITY: approximately 60 - 75% success rate

Typical Decision after IOT&E: Begin fielding ASAP, even before . . . .

Suitability problems are addressed

Reliability is improved

Maintenance procedures are mature

Training is complete

. . . .

. . . .

Why field before addressing these problems? Urgent Combat Need

Suitability . . . at what cost?

Typical IOT&E Evaluation Results:

EFFECTIVENESS: approximately 90% success rate

SUITABILITY: approximately 60 - 75% success rate

Typical Decision after IOT&E: Begin fielding ASAP, even <u>before</u> . . . .

Suitability problems are addressed

Reliability is improved

Maintenance procedures are mature

Training is complete

. . . .

. . . .

Why field before addressing these problems? Urgent Combat Need

The QUESTION: How much does it cost us to do business this way?

BACKGROUND

2006 DOTE Annual Report to Congress:

<u>Dr. McQueary's 3 Observations:</u>

1. OT&E is too often the place where performance deficiencies are discovered

2.

3.

BACKGROUND

2006 DOTE Annual Report to Congress:

Dr. McQueary's 3 Observations:

1. OT&E is too often the place where performance deficiencies are discovered

2. DoD Acquisition is too slow (warfighters need more rapid fielding of new technologies)

3.

BACKGROUND

2006 DOTE Annual Report to Congress:

Dr. McQueary's 3 Observations:

1. OT&E is too often the place where performance deficiencies are discovered

2. DoD Acquisition is too slow (warfighters need more rapid fielding of new technologies)

3. Operational Suitability is too low, and needs to improve.

Suitability . . . at what cost?

DAU Research Study Proposal

Investigate various types of systems

Total of 5 or 6, several from each service

Criteria:

- Recently fielded
- Evaluated to be Effective but not "fully" Suitable

Examine performance of systems wrt suitability

Determine suitability cost drivers

Evaluate suitability trends

Sponsor Decision: Start with one program, work from there . . . . .

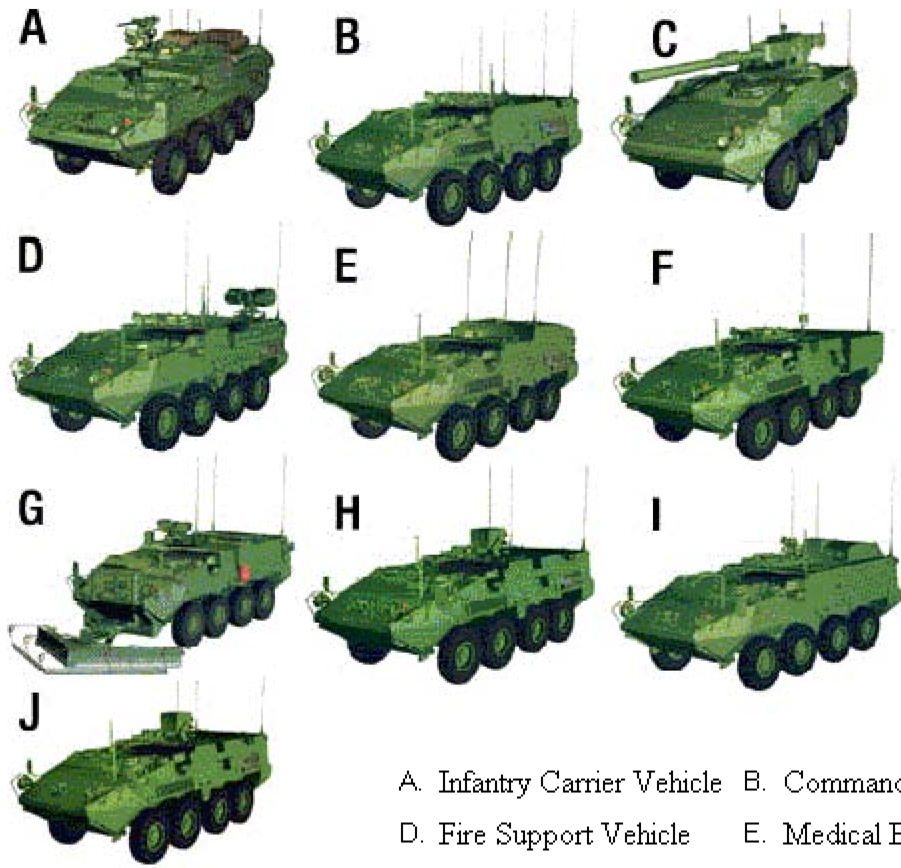
First Program Selected: STRYKER Family of Vehicles

Additional Study Candidates: TBD

Stryker Family of Vehicles

STRYKER FAMILY OF VEHICLES

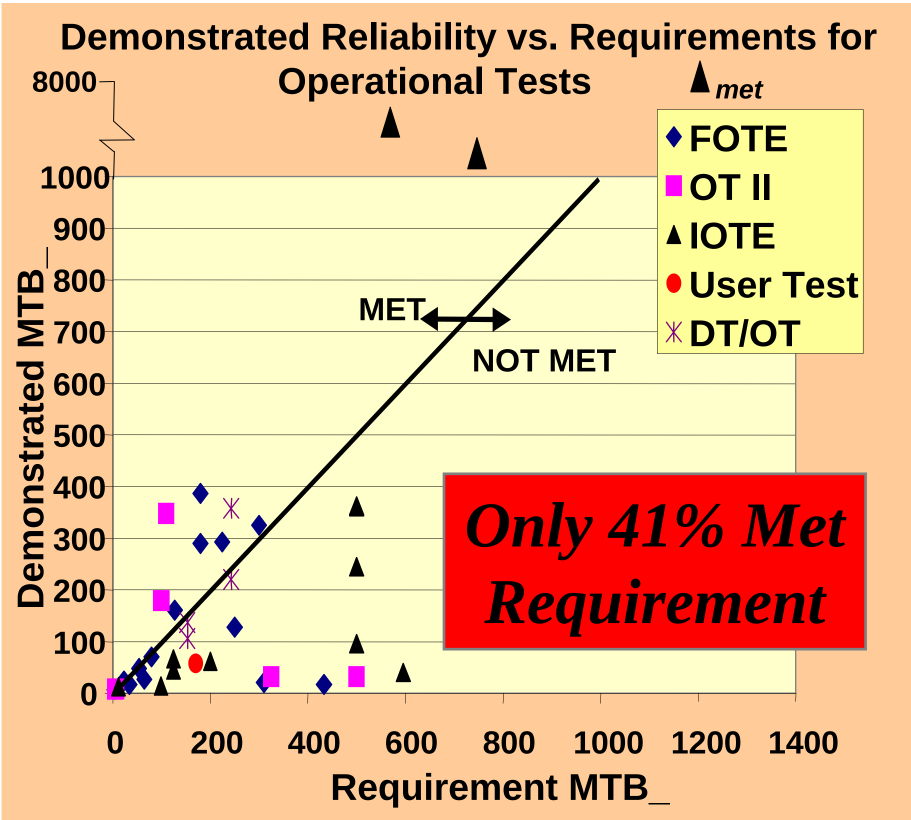
In service with the US Army



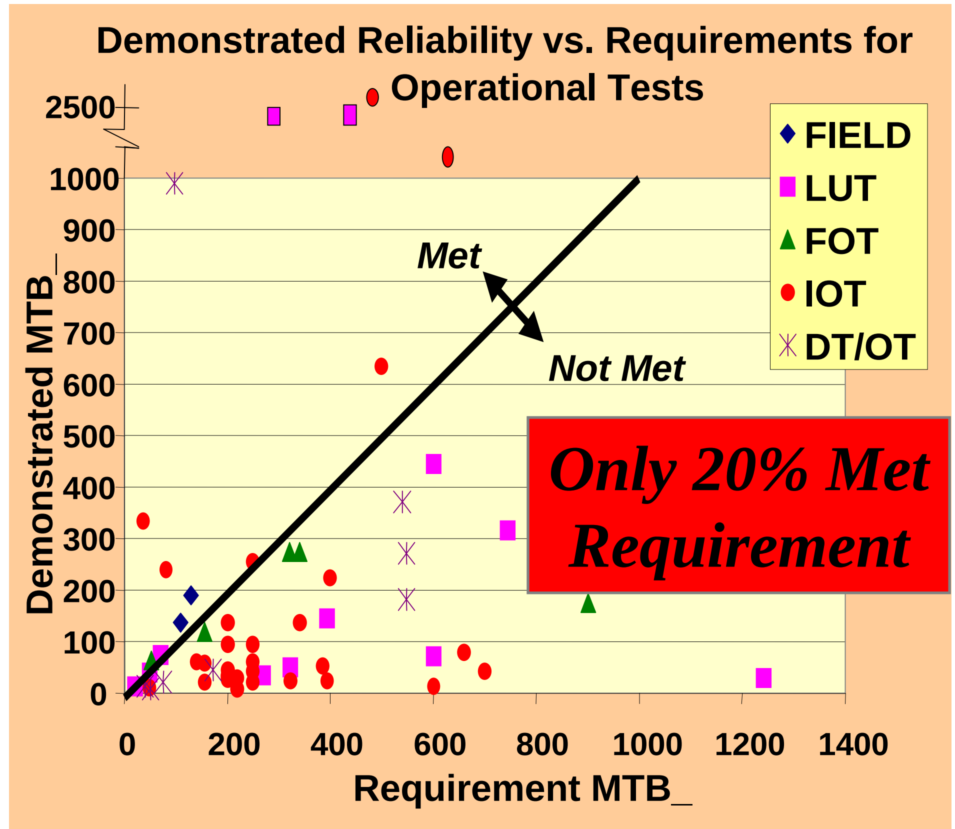
A. Infantry Carrier Vehicle
B. Command Vehicle
C. Mobile Gun System
D. Fire Support Vehicle
E. Medical Evacuation
F. Mortar Carrier
G. Engineer Squad Vehicle
H. Anti-tank Guided Missle
I. NBC Reconnaissance
J. Reconnaissance Vehicle

Now, back to Suitability . . . .

ATEC Reliability Track Record



1985-1990

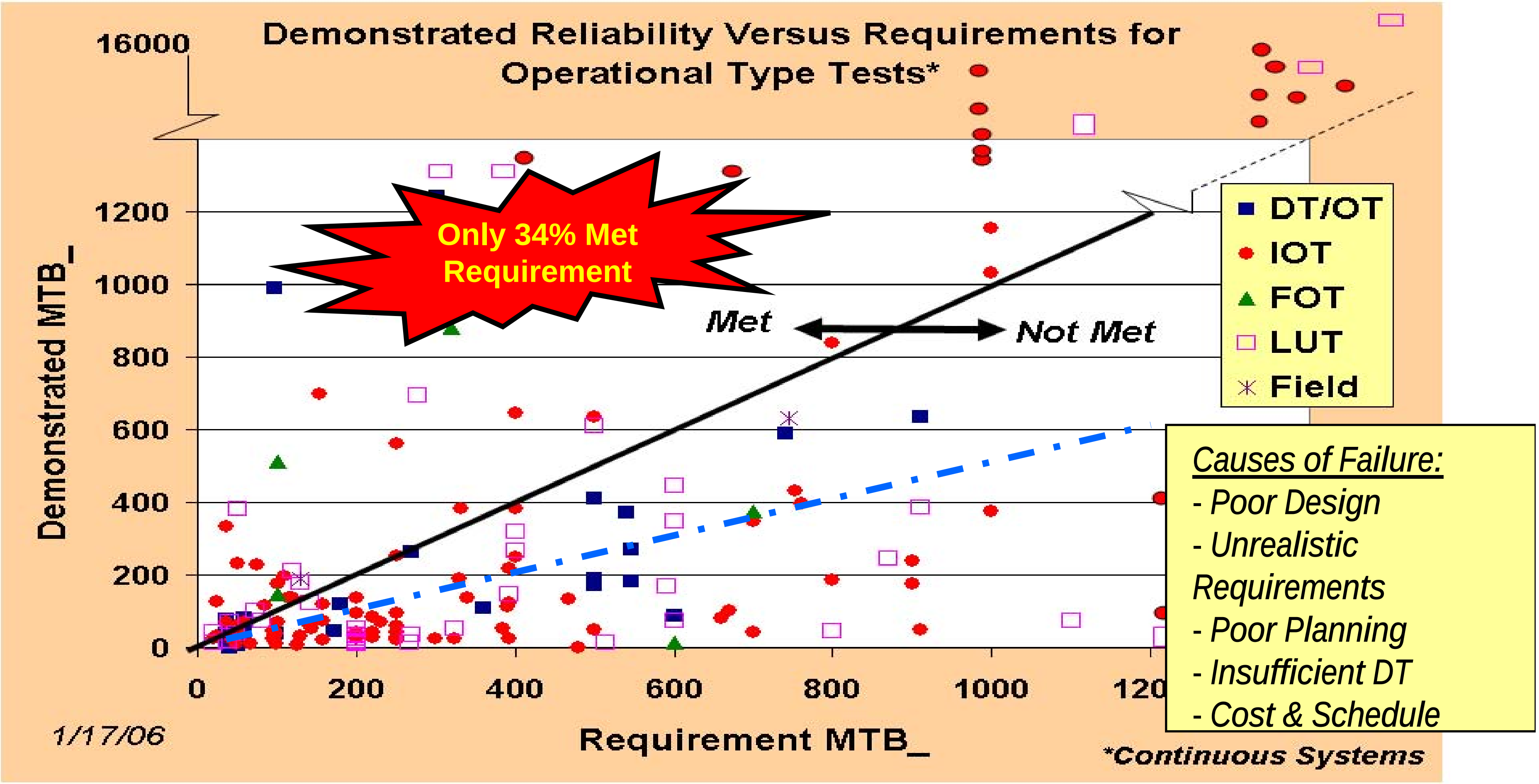


1996-2000

Most Of Our Systems Fail To Achieve Reliability Requirements In OT

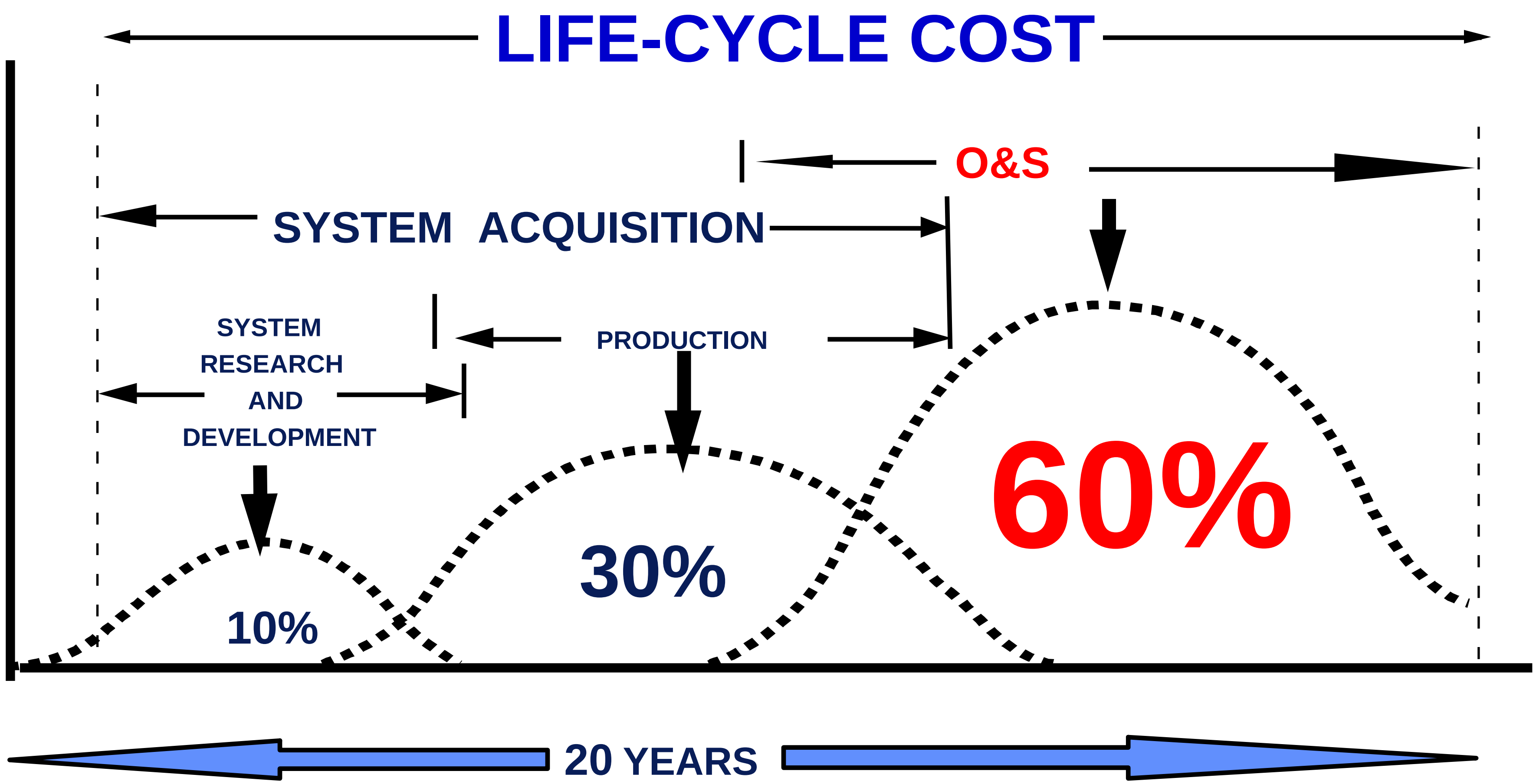
. . . And The Trend Appears To Be Continuing Downward source: ATEC

1996 - 2006

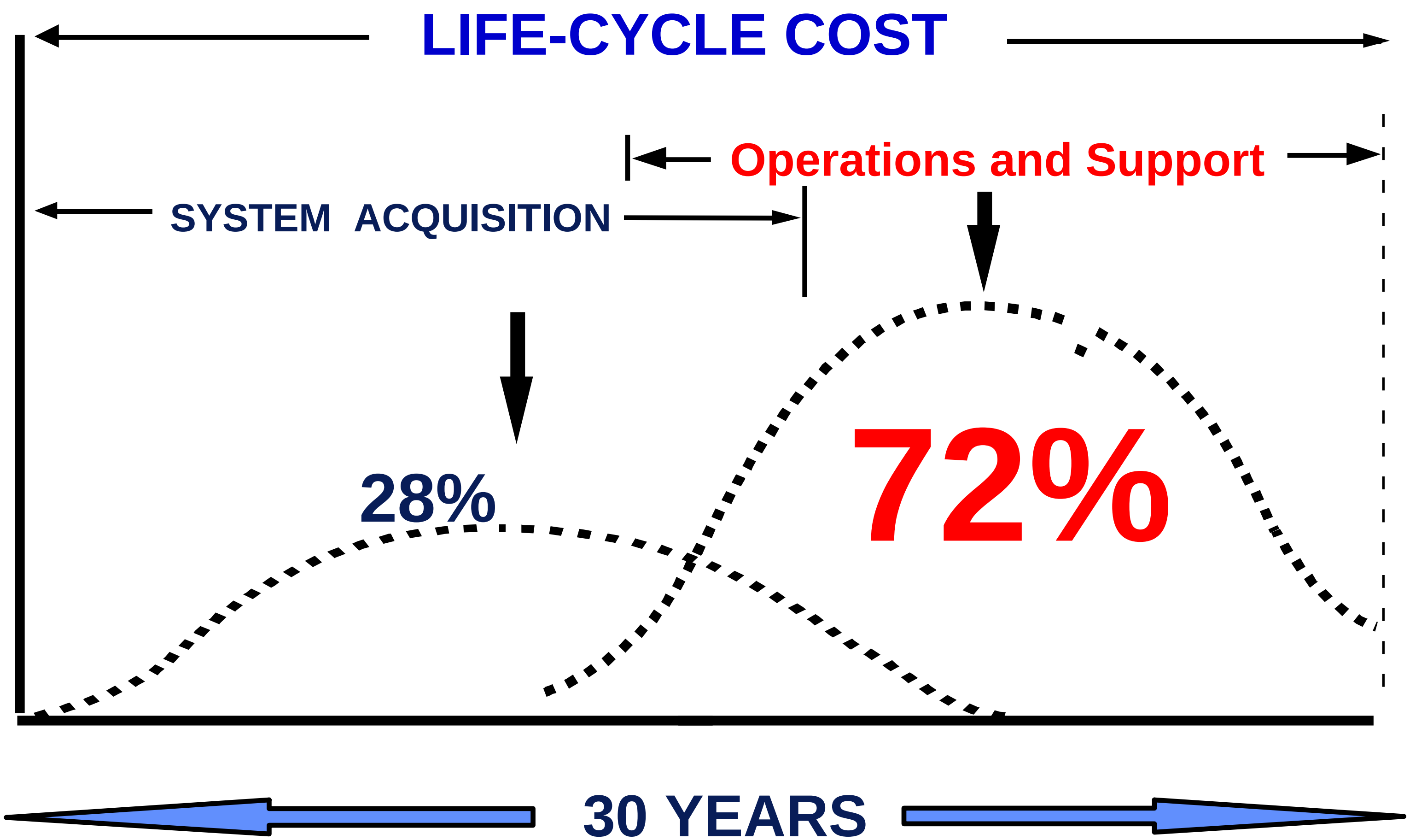


Amongst Systems Which Did Not Meet Reliability Requirements In OT, 75% Of Them Failed To Achieve Half Of Their Requirement

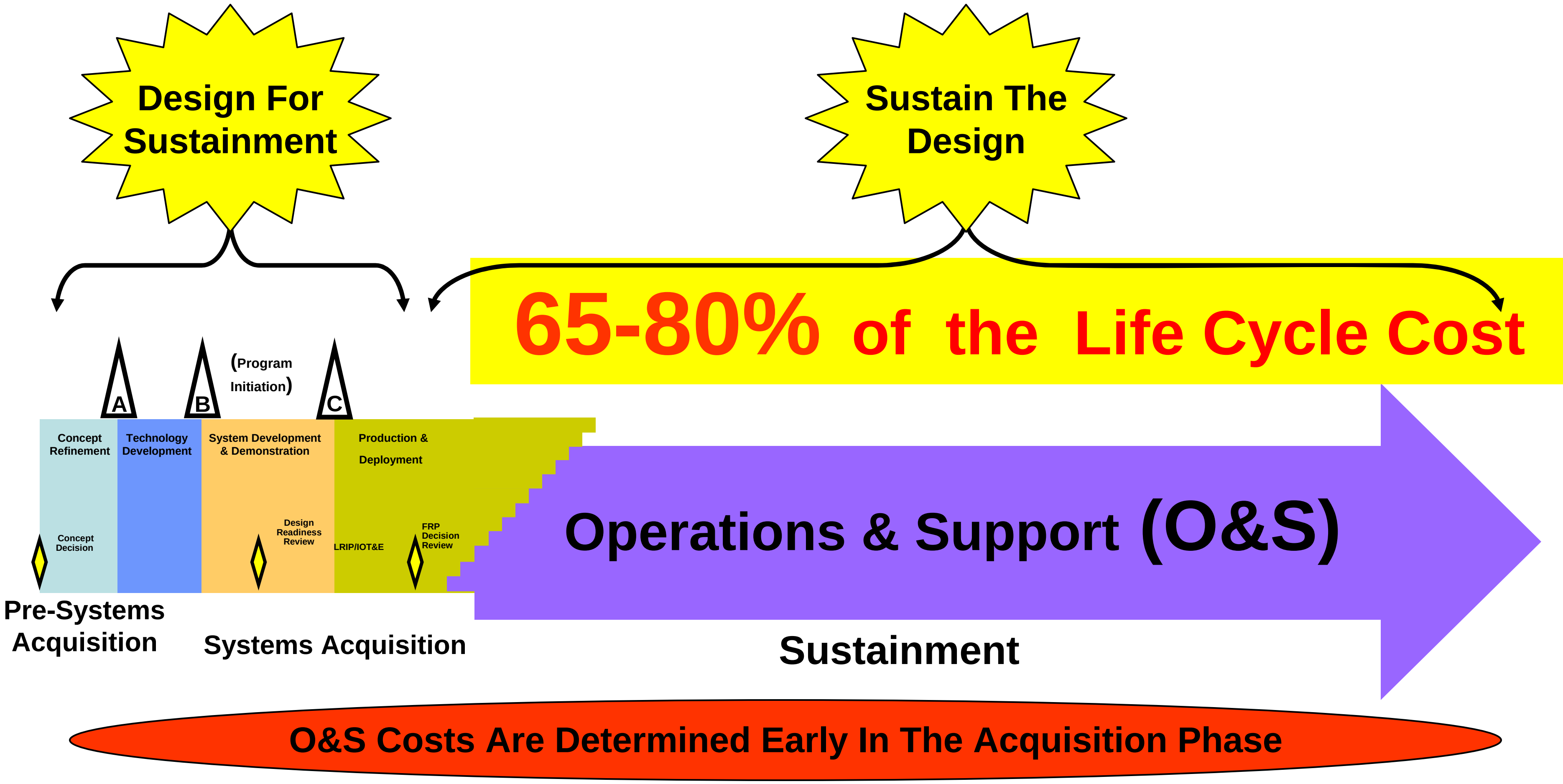
LCC Distribution



LCC Distribution



Life Cycle Management

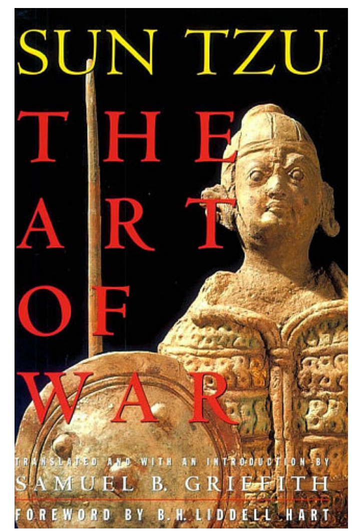


USD(AT&L) Strategic Goals Emphasize Sustainment Outcomes Throughout The Life Cycle Management Process

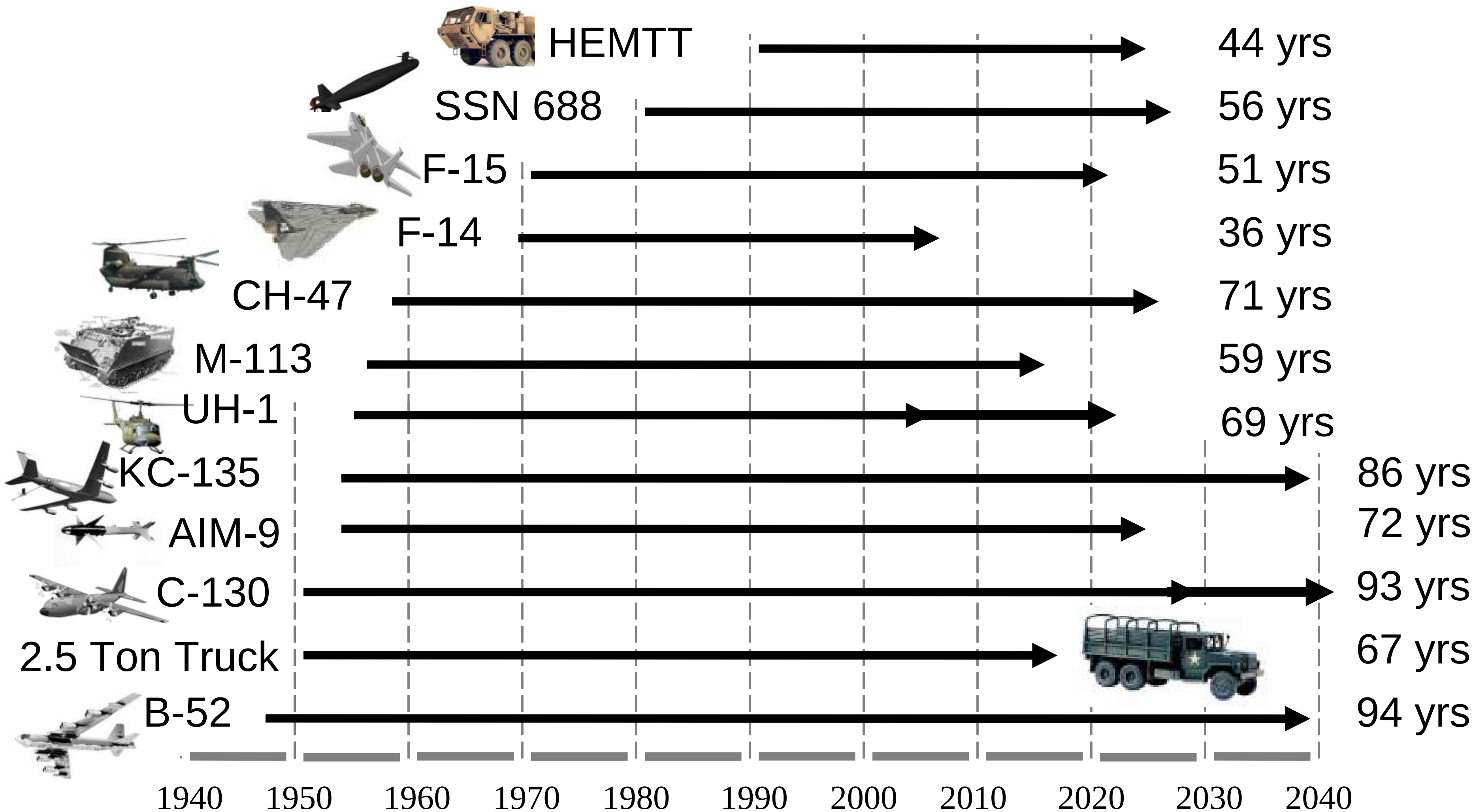
Life Cycle Costing Considerations

"As Government expenditures, those due to broken down chariots, worn-out horses, armor and helmets, arrows, and crossbows, lances, hand and body shields, draft animals and supply wagons will amount to 60% of the total."

Sun Tzu (The Art of War, 6th Century B.C.)



Defense System Life Cycles



SOURCE: John F. Phillips DUSD (L)

DoD Directive (5000.1)

"PMs shall consider supportability, life cycle costs, performance, and schedule comparable in making program decisions."

Department of Defense
DIRECTIVE

NUMBER 5000.1
May 12, 2003

USD(AT&L)

SUBJECT: The Defense Acquisition System

References:

(a) DoD Directive 5000.1, "The Defense Acquisition System," October 23, 2000 (hereby canceled)
(b) DoD Instruction 5000.2, "Operation of the Defense Acquisition System," May 12, 2003
(c) DoD 5025.1-M, "DoD Directives System Procedures," current edition
(d) Title 10, United States Code, "Armed Forces"
(e) Section 2350a of title 10, United States Code, "Cooperative Research and Development Projects: Allied Countries"
(f) Section 2751 of title 22, United States Code, "Need for international defense cooperation and military export controls; Presidential waiver; report to Congress; arms sales policy"
(g) Section 2531 of title 10, United States Code, "Defense memoranda of understanding and related agreements"
(h) Federal Acquisition Regulation (FAR), current edition
(i) Section 1004, Public Law 107-314, "Bob Stump National Defense Authorization Act for Fiscal Year 2003," "Development and Implementation of Financial Management Enterprise Architecture"
(j) DoD Directive 8500.1, "Information Assurance (IA)," October 24, 2002
(k) DoD Directive 4630.5, "Interoperability and Supportability of Information Technology (IT) and National Security Systems (NSS)," January 11, 2002
(l) DoD Directive 2060.1, "Implementation of, and Compliance with, Arms Control Agreements," January 9, 2001

1. PURPOSE

This Directive:

1.1. Reissues reference (a) and authorizes publication of reference (b).

1.2. Along with reference (b), provides management principles and mandatory policies and procedures for managing all acquisition programs.

2. APPLICABILITY AND SCOPE

2.1. This Directive applies to the Office of the Secretary of Defense, the Military Departments, the Chairman of the Joint Chiefs of Staff, the Combatant Commands, the Office of the Inspector General of the Department of Defense, the Defense Agencies, the DoD Field Activities, and all organizational entities within the Department of Defense (hereafter collectively referred to as "the DoD Components").

2.2. The policies in this Directive apply to all acquisition programs.

AT&L Memo: 22 Nov 2004

(Subj: Total Life Cycle Systems Management (TLCSM) Metrics)

Emphasizes use of PBL (Performance-Based Logistics) for all weapons

Provides Specific Definitions (and Formulas) for the following metrics:

1. **Ao (Operational Availability)**
2. **Mission Reliability**
3. **TLCS Cost per Unit of Usage**
4. **Cost per Unit of Usage**
5. **Logistics Footprint**
6. **Logistics Response Time**

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

NOV 2 2 2005

ACQUISITION, TECHNOLOGY AND LOGISTICS

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
(ATTN: SERVICE ACQUISITION EXECUTIVES)

SUBJECT: Total Life Cycle Systems Management (TLCSM) Metrics

The Defense Business Board recommended to the Deputy Secretary of Defense that the Department aggressively pursue implementation of Performance-Based Logistics, for all its weapons, new and legacy.

In a memorandum dated August 16, 2004, my predecessor directed measuring performance in terms of Operational Availability, Mission Reliability, Cost per Unit of Usage, Logistics Footprint, and Logistics Response time. For consistency, this memorandum provides specific definitions of these metrics for use across the Department (attached). I direct their use as the standard set of metrics for evaluating overall TLCSM.

I also direct the TLCSM Executive Council to develop a "TLCSM Metrics Handbook," with specific metrics, formulas and calculation methodologies. It will be used in performance-based contracts and for sustainment oversight. The handbook will also define supporting data requirements that should be incorporated into emerging logistics information systems.

The principal point of contact for administration of the handbook is Mr. Lou Kratz, Assistant Deputy Under Secretary of Defense (Logistics Plans and Programs), 703-614-6327, Louis.Kratz@osd.mil.

Kenneth J. Krieg

Attachment:
As stated

JROC Memo: 17 Aug 2006

(Subj: Key Performance Parameters Study Recommendations and Implementation)

1. Endorsed Mandatory "MATERIEL AVAILABILITY" Key Performance Parameter (KPP) for all MDAPs and Select ACAT II and III
With 2 Supporting Key System Attributes (KSAs):
A. Materiel Reliability
B. Ownership Costs

2. Endorsed ENERGY EFFICIENCY KPP for selected programs, as appropriate

3. Endorsed TRAINING KPP for selected programs, as appropriate

4. Did not endorse requirement for mandatory KPPs for these criteria:
COST
TIME and/or SCHEDULE
SUSTAINMENT
COALITION INTEROPERABILITY
FORCE PROTECTION AND SURVIVABILITY

THE JOINT STAFF
WASHINGTON, D.C. 20318-8000

JOINT REQUIREMENTS OVERSIGHT COUNCIL

JROCM 161-06
17 August 2006

MEMORANDUM FOR: Under Secretary of Defense for Acquisition, Technology, and Logistics
Commander, US Joint Forces Command
Vice Chief of Staff, US Army
Vice Chief of Naval Operations
Vice Chief of Staff, US Air Force
Assistant Commandant of the Marine Corps

Subject: Key Performance Parameter Study Recommendations and Implementation

1. The Joint Requirements Oversight Council (JROC) approved the Key Performance Parameter (KPP) Study recommendations. The JROC endorses the implementation of a mandated Materiel Availability KPP with supporting key system attributes of materiel reliability and ownership cost for all Major Defense Acquisition Programs (MDAPs) and select ACAT II and III programs. The JROC also endorsed selectively applying an Energy Efficiency KPP and a System Training KPP, as appropriate.

2. To better ensure the correct KPPs are selected, the JROC endorsed the use of KPP reference sheets produced as part of this study. The KPP reference sheets will be used as an aid in the process of identifying and validating potential KPPs for any acquisition program.

3. Implementation of the study recommendations will be concurrent with the publishing of the next revision of CJCS 3170-series documents. The revision will incorporate the details of the execution and will be coordinated for final release by 31 October 2006. Specific JROC implementation due backs and approved recommendations are enclosed.

E. P. Giambastiani

E. P. GIAMBASTIANI
Admiral, US Navy
Vice Chairman
of the Joint Chiefs of Staff

Enclosure

JROC Approved* Mandatory Sustainment KPP and KSAs

- **<u>Single KPP:</u>**
  - **Materiel Availability** $\left(= \frac{\text{Number of End Items Operational}}{\text{Total Population of End Items}}\right)$
- **<u>Mandatory KSAs:</u>**
  - **Materiel Reliability** (MTBF) $\left(= \frac{\text{Total Operating Hours}}{\text{Total Number of Failures}}\right)$
  - **Ownership Cost** (O&S costs associated w/materiel readiness)
- **For mission success, Combatant Commanders need:**
  - Correct number of operational end items <u>capable</u> of performing the mission when needed
  - Confidence that systems will perform the mission and return home safely without failure
- **Ownership Cost provides balance; solutions cannot be availability and reliability "at any cost."**

JROC Approval Letter JROCM 161-06 Signed 17 Aug 06; Revised CJCS 3170 will put into Policy

“Proposed” Life Cycle Sustainment Outcome Metrics (2006)

- **Materiel Availability (KPP*)**
  - A Key Data Element Used In Maintenance And Logistics Planning
- **Material Reliability (KSA*)**
  - Provides A Measure Of How Often The System Fails/Requires Maintenance
  - Another Key Data Element In Forecasting Maintenance/Logistics Needs
- **Ownership Cost (KSA*)**
  - Focused On The Sustainment Aspects Of The System
  - An Essential Metric For Sustainment Planning And Execution
  - Useful For Trend Analyses – Supports Design Improvements/Modifications
- **Mean Downtime**
  - A Measure Of How Long A System Will Be Unavailable After A Failure
  - Another Key Piece Used In The Maintenance/Logistics Planning Process
- **Other Sustainment Outcome Metrics May Be Critical To Specific Systems, And Should Be Added As Appropriate**

* Sustainment KPP & KSAs Included In Revised Draft CJCSM 3170

These 4 Life Cycle Sustainment Outcome Metrics Are Universal Across All Programs And Are Essential To Effective Sustainment Planning

DUSD AT&L Metrics Evolution

USD AT&L TLCSM Metrics (Nov 05)	DUSD L&MR Life Cycle Sustainment Metrics (Mar 07)
• *Operational Availability (A_o)*	• **Materiel Availability (1)** • *Key Performance Parameter (KPP) (per Aug 06 JROC Memo)*
• *Mission Reliability*	• **Material Reliability (2)** • *New Key System Attribute (KSA) (per Aug 06 JROC Memo)*
• *Total Life Cycle System Cost per Unit of Usage* • *Cost Per Unit of Usage*	• **Ownership Cost (3)** • *New Key System Attribute (KSA) (per Aug 06 JROC Memo)*
• *Logistics Footprint*	• ***No Corresponding New Metric***
• *Logistics Response Time (LRT)*	• **Mean Down Time (MDT) (4)**

DUSD (L&MR) Memo – 10 March 2007

Subj: Life Cycle Sustainment Metric Outcomes

. . . In July 2006, JROC established *mandatory* KPP: "Materiel Availability" along with KSAs: "Material Reliability" and "Ownership Costs"

This memo (March 2007) provides definitions of these terms and adds one additional parameter: "Mean Down Time"

BOTTOM LINE: Specific program goals for these "four materiel readiness outcomes" will be established early in the concept decision process and refined throughout the system development process. Status towards these goals should be reported at Program Reviews (DAB, DAES, etc.):

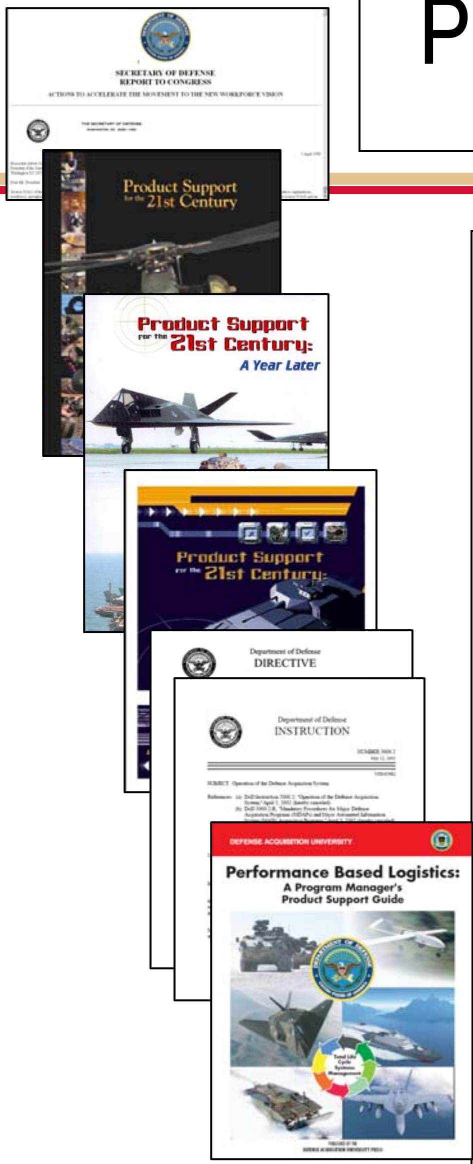
1. Materiel Availability
2. Material Reliability
3. Ownership Costs
4. Mean Down Time

DUSD (L&MR) Memo – 10 March 2007

14 Life Cycle Sustainment (LCS) Enablers

1. Performance Based Logistics (PBL)
2. Corrosion Prevention
3. Item Unique Identification (IUID)/Serialized Item Management (SIM)
4. Tech Data/IETM
5. Condition-Based Maintenance (CBM+)
6. Continuous Process Improvement (CPI)
7. Title 10 Partnering Requirements - 50/50
8. Depot Maintenance Plan
9. Obsolescence Plan, Diminishing Manufacturing Sources and Material Shortages (DMSMS)
10. Training
11. Integrated Supply Chain Management (SCM)
12. Radio Frequency Identification (RFID)
13. Predictive Modeling
14. Long Term Performance Based Agreements (PBA)

PBL Guidance Evolution, 1998-2008



- **Fiscal Year 1998 Section 912(c) of the National Defense Authorization Act** (not shown)
- **"Secretary of Defense Report to Congress: Actions to Accelerate the Movement to the New Workforce Vision" in Response to Section 912(c) of the NDAA for FY 1998 *(Apr 1998)***
- **Product Support for the 21st Century: Report of the Department of Defense (DoD) Product Support Reengineering Implementation Team *Section 912(c)* *(Jul 1999)***
- **Product Support for the 21st Century: A Year Later *(Sep 2000)***
- **Product Support for the 21st Century: A Program Manager's Guide to Buying Performance *(Nov 2001)***
- **DoDD 5000.1 The Defense Acquisition System *(May 2003)* and DoDI 5000.2 Operation of the Defense Acquisition System *(May 2003)***
- **Defense Acquisition Guidebook (DAG), Chapter 5 *(2004 & After)*** *(not shown)*
- **Performance Based Logistics: A Program Manager's Product Support Guide *(Mar 2005)***

"My vision of the acquisition workforce 10 years from now is one that is smaller and in fewer organizations; is focused on managing suppliers, rather than supplies; and is focused on the total cost of ownership to provide and support high quality goods and services required by our warfighting men and women."
-- Secretary of Defense William Cohen, April 1998

Stryker Suitability Study

- **Research Objective**
  - To conduct a research study to quantify the difference between projected O&S costs (associated with the RAM requirement) and the actual costs associated with the achieved level of operational suitability. That is, quantify the costs of not achieving adequate levels of operational suitability.

Research Proposal:

Examine suitability performance

Determine suitability cost drivers

Evaluate suitability trends

Process

- **Phase 1- Initial Program (Stryker)**
  - a. Understand the problem
  - b. Define detailed study objectives
  - c. Collect data
  - d. Analyze data and build models
  - e. IPR at T&E Conference - Hilton Head
  - f. Acquire additional data as needed
  - g. Draft report
  - h. Finalize report

- **Phase 2 - Analysis of 5 additional programs covering multiple types**

Data Collection

- Stryker PM Team (TACOM Warren, MI)
- AEC RAM Directorate – Aberdeen (ATEC)
- OTC Reps (Ft. Hood, TX)
- AT&L Rep (Pentagon, WASH DC)
- IDA (Arlington, VA)
- LMI (Falls Church, VA)
- GDLS CDRL Data (Warren, MI)
- Fort Lewis Stryker Team (Ft Lewis, WA)

Findings & Observations

- Warfighters very satisfied with Stryker performance in-theatre
- Brigade Commanders extremely happy with ICLS
- High Operational Readiness Rates, but ORR is prioritized over support costs
- Very High Op Temp in-theatre
- Operational Environment much different than expected
  - Mission Profile not accurate (80% Primary Roads)
  - Harsh usage – roads, curbs, higher tire pressure, excess weight
  - Excessive stresses on vehicle:
    - Over-inflated tires – auto system doesn't work (log burden)
    - High tire replacement rate
    - Wheel spindles fatigue cracks

Findings & Observations

- **Combat re-configurations necessary for safety:**
  - **Armor, RPG Cage, Sand Bags … add excessive weight to vehicle (affecting reliability and performance)**
- **Army did not buy Tech Data Pkg – "Prohibitively expensive" . . . risk to government**

Other Findings

- **Immature Maintenance Procedures- many procedures have not been validated in IETMs (interactive electronic tech manuals) lead to:**
  - **"*Tribal System Maintenance*" from experienced crews (". . . that new book isn't any good . . . . this is the way it worked on the M113, so do it like this")**

- **With Kr support to maintain vehicles, soldier crews develop "*rental car mentality*" . . .**
  - **Lack of ownership mentality . . . overly dependent on contractor**
  - **Sometimes they forget the basics (oil check)**
  - **One vehicle lost because pre-mission checks were ignored**

Other Findings

- **Stryker initial deployment/fielding was extremely accelerated to meet urgent combat need**
  - **Result was that Army was doing these things concurrently:**
    - **Testing**
    - **Producing**
    - **Fielding**
    - **Conducting combat operations**

- **The threat <u>and</u> the operational environment were much different than anticipated**

Defense Acquisition University

Cost Per Mile Analysis

Cost Per Mile (CPM)

- **CPM is a planning tool used to project future budget requirements.**
- **No specific value of CPM required by contract.**
- **Govt/Kr both calculate CPM independently, and use results to negotiate parts cost forecasts to determine purchasing requirements .**
- **This research project resulted in an independent computation of CPM.**

Data Collected

- CDRL A003 (Aug 2006)
  - Parts Consumption Report (for ~ 1 yr)
  - Good quality data (possibly some errors in mileage or dates)
- CDRL A004 (Aug 2006)
  - Repairable Items Repair Cost Summary
  - Most repair items have estimates or quotes
  - ~ 26% of total consumable parts___ % parts

Cost Per Mile Analysis

$$\text{Cost Per Mile} = \frac{\text{Labor + Replacement Parts + Part Repair}}{\text{Total Vehicle Mileage}}$$

Labor : Average of $4.73M per brigade

Replacement Parts : from CDRL A003 Consumption Report

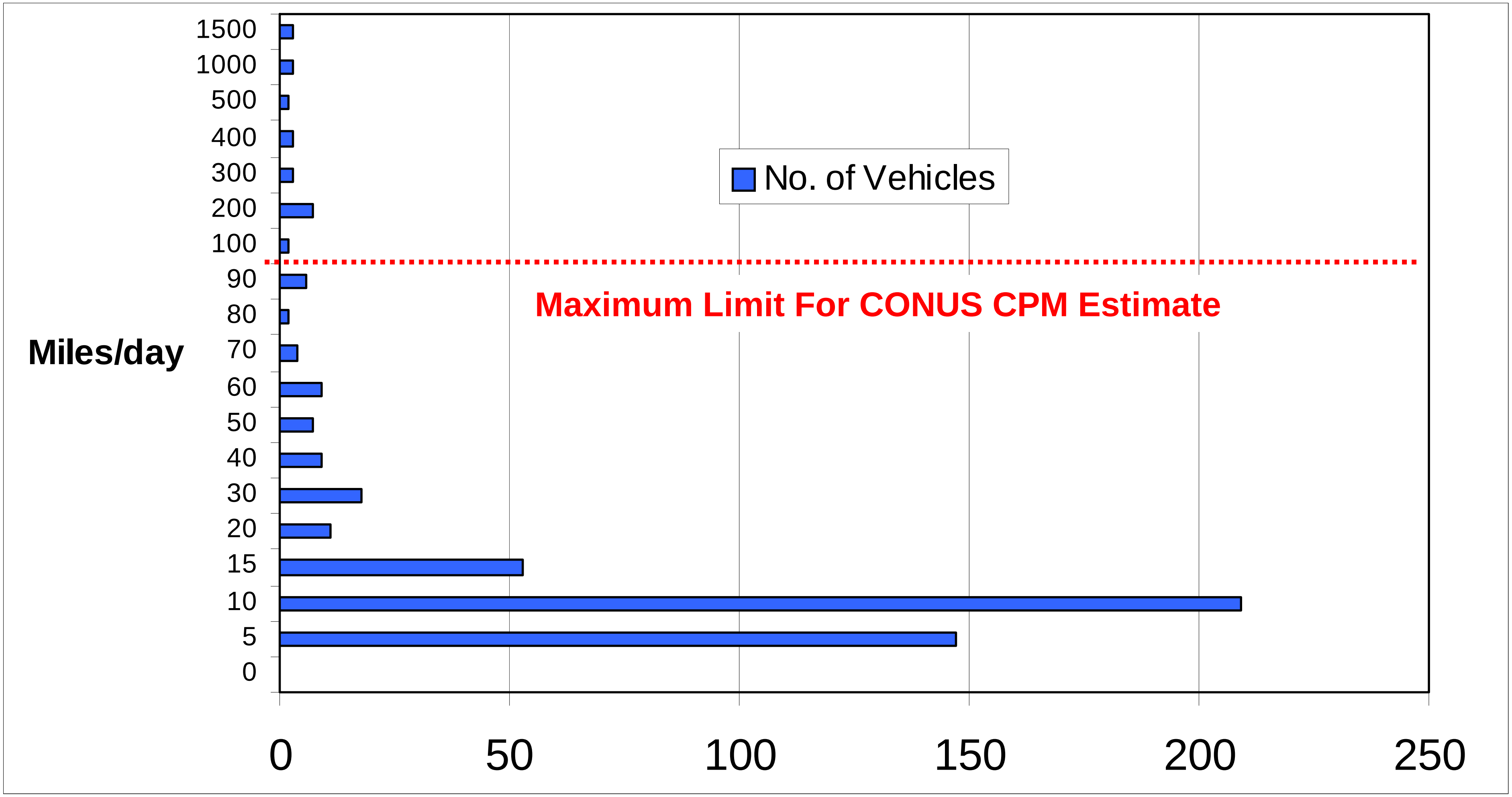
Part Repair : No historical data for many parts

Existing data from CDRL A004 (Repairable Items Repair Cost Summary

Vehicle Mileage : Does not exist for all vehicles

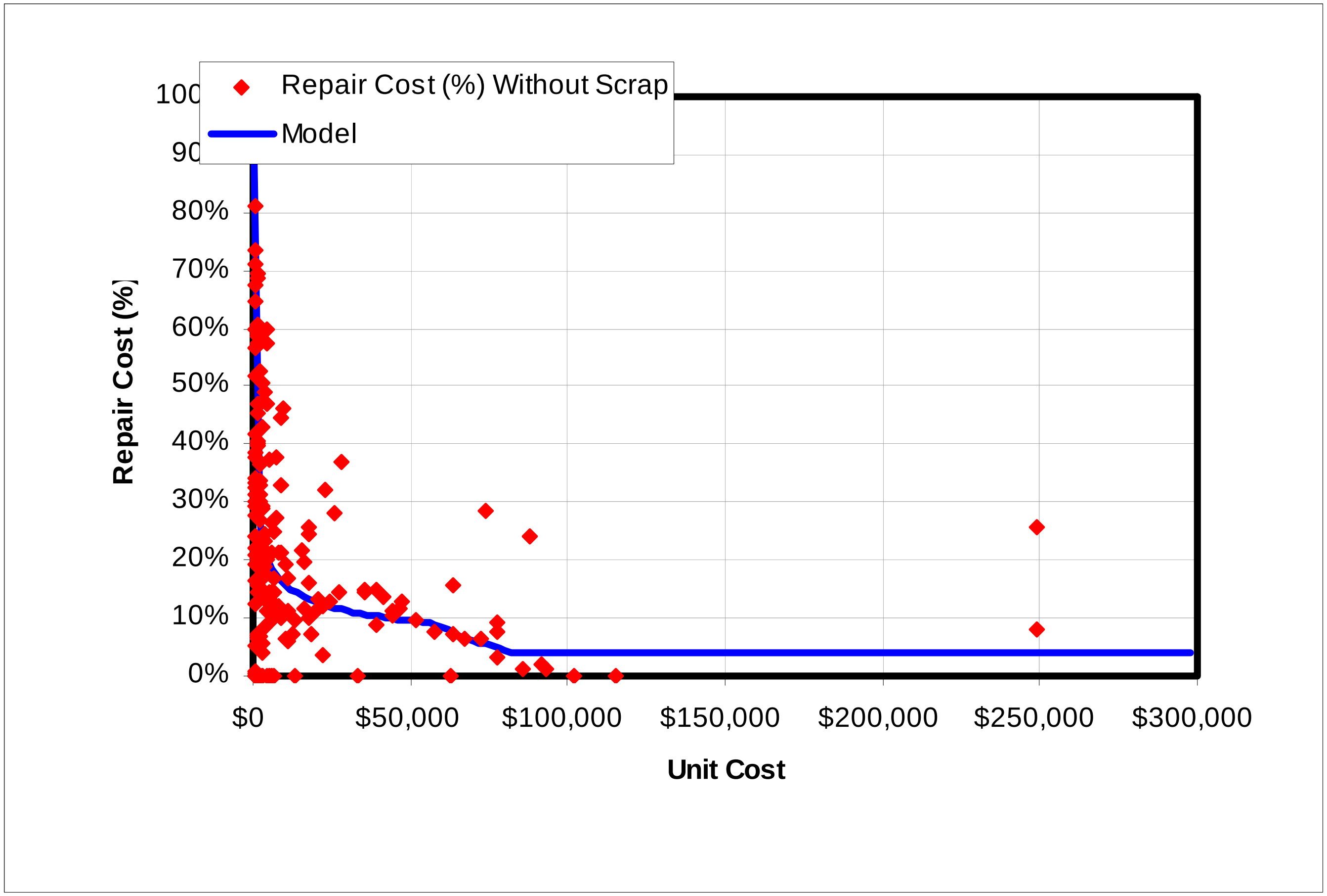
Questionable accuracy

Vehicle Miles Per Day From A003 (CONUS)



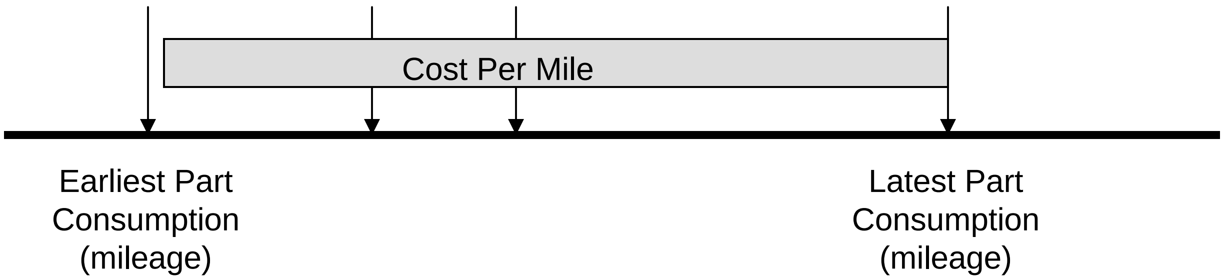
Repair Costs Parametric Model

- Parametric model to estimate repair costs as a function of replacement cost.
- Did not factor in warranty items



Estimating the Repair Cost per Mile

For each vehicle



- <u>Estimate cost per mile from consumption report.</u>
  - Vehicle mileage
  - Quantity consumed
  - Average repair cost (including scrap nbut not including warranty)
  - Correction needed to raw data.

CONUS Cost/Mile

ICLS Labor, Replacement Parts, Part Repair

Vehicle Type	No. Vehicles	Repair Cost in Computation	Total Mileage in Computation	Spares/ Repair Parts Cost/mile	Miles Per Day	Total CPM
ICV	345	$1,581,641	218,138	$7.25	7.56	$9.41
MCV	101	$279,921	22,504	$12.44	5.39	$14.59
ATGM	43	$172,499	20,200	$8.54	6.67	$10.69
ESV	29	$395,797	28,970	$13.66	9.51	$15.82
FSV	33	$165,540	18,558	$8.92	6.90	$11.08
MEV	35	$66,682	17,405	$3.83	6.16	$5.99
RV	161	$559,520	110,313	$5.07	7.32	$7.23
All vehicles	**747**	**$3,221,599**	**436,088**	**$7.39**	7.31	$13.30

Assumptions: Each vehicle < 5k total miles, < 100 miles/day average, 30% repair cost for Power Pack

Deployed Cost per Mile

ICLS Labor, Replacement Parts, Part Repair

Vehicle Type	No. Vehicles	Repair Cost in Computation	Total Mileage in Computation	Spares/ Repair Parts Cost/mile	Miles Per Day	Total CPM
ICV	315	$8,225,102	1,108,756	$7.42	36.93	$9.57
MCV	70	$765,983	120,708	$6.35	22.08	$8.50
ATGM	52	$1,393,062	218,260	$6.38	43.50	$8.54
ESV	28	$587,658	134,119	$4.38	64.33	$6.54
FSV	27	$486,028	95,890	$5.07	36.94	$7.22
MEV	38	$223,414	79,945	$2.79	25.70	$4.95
RV	126	$2,303,741	317,632	$7.25	31.72	$9.41
All vehicles	**656**	**$13,984,989**	**2,075,310**	**$6.74**	35.59	$7.95

– Model assumes $4.73M per brigade

– Higher miles/day for Deployed vehicles results in lower Total Cost Per Mile

Assumptions: Each vehicle < 20k total miles, < 400 miles/day average, 30% repair cost for Power Pack

Cost Per Mile (CPM) Estimates

- CPM estimate - $17.19 (GAO 04-925, including labor, parts & repair)
- CPM estimate - $18.78 (Stryker R-TOC Brief)
- CPM estimate - $18.23 (based on M113 methodology w/Stryker adjustments)
- CPM estimate - $14.53 (based on initial 4 month deployment data)
- CPM estimate (GDLS) - $13.52 garrison
$ 8.88 deployed
- DAU CPM estimate – $ 13.30 garrison
$ 7.95 deployed

Conclusions

Stryker was not designed for the threat it is facing.

Stryker was not designed for the operational environment it is experiencing.

Accelerated deployment resulted in many concurrent activities: Testing, Production, Deployment, Combat

Stryker is doing the job. Crews are overcoming obstacles.

Costs of marginal suitability is not determined. Data not available.

Conclusions

<u>OPERATIONAL READINESS RATE (ORR):</u>

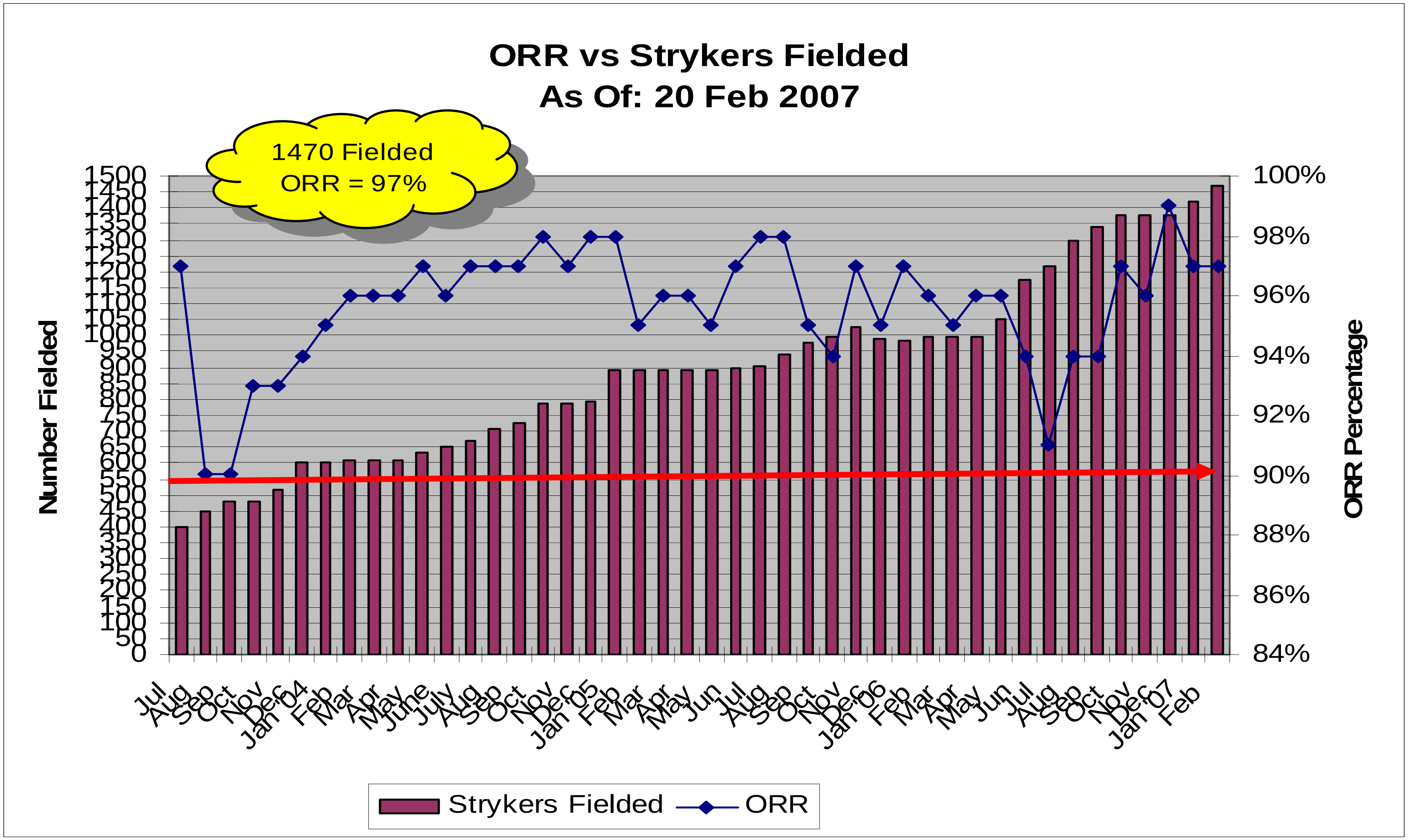
- **Contractual requirement: ORR $\geq$ 90%**
  - **Does not include GFE (base vehicle configuration only)**
- **Stryker consistently above requirement**
  - **Recent ORR data point: 97% (20 Feb 07)**
- **Cost-plus-fixed-fee contract motivates GDLS to meet ORR . . . .**
  - **However, contract does <u>not</u> incentivise controlling costs . . . risk to government**
  - **Example – to repair cracked hydraulic reservoirs in power pack, whole power pack is replaced in field**

Conclusions

OPERATIONAL READINESS RATE (ORR):

- **Operational Readiness Rate not necessarily consistent with traditional A_o (Operational Availability)**
  - RAM issues can be masked by ORR
- **Mission Completion vs. Subsystem Failure**
  - Possibly leads to overestimating system reliability due to non-reporting on individual subsystem (component) failures
  - Multi-mission vehicle – with subsystem failures, system can still perform alternate missions
- **Reporting Criteria Issue:**
  - ORR vs. MTBF of individual subsystems

Stryker Fleet Readiness



Conclusions

RELIABILITY ISSUES:

- **Reliability requirement as defined in ORD are not appropriate**
  - **4.3.1.3. The Stryker (vehicle only, excluding GFE components/systems) will have a reliability of 1000 mean miles between critical failure (i.e., system aborts).**
- **Reliability issues and cost drivers found during DT/OT correlate well with fielded experience**

Conclusions

OPERATIONAL ENVIRONMENT:

- **Field usage much harsher than planned**
  - e.g., higher tire pressure, roads, curbs, weight (armor, sandbags)
- **Mission Profile says 80% XCountry, 20% Primary Roads**
  - in-theater mission just the opposite . . . most missions in urban environment (police action) on paved roads
- **OpTempo very high (>10X)**
  - High OpTempo may improve reliability numbers, but beats up equipment
  - With low usage, seals can dry up, humidity can build up in electrical components
- **Changes in mission & configuration are putting excess stress on vehicle: armor/sandbags, over inflated tires, going over curbs**
  - replacing 9 tires/day (>3200 tires/yr)
  - wheel spindles developing fatigue cracks
  - drive shafts breaking
  - prescribed tire pressure is 80 PSI, however, with slat armor/sandbags – must maintain >95 PSI
  - 95 PSI is a logistics burden on operators
    - Must be maintained by the soldier (tire inflation system can't do it)
    - Soldiers must check tire pressure more than 3 times per day to maintain 95 PSI

Conclusions

TACTICAL CONSIDERATIONS:

- **Slat Armor & cage design (additional 5000 lb) is effective for many RPG threats, but negatively impacts size, weight and performance of Stryker**
  - **Causes multiple problems for safe and effective operation**
    - Slat armor on rear ramp too heavy - greatly strains lifting equipment
      - Occasionally, crews must assist raising/lowering ramp
    - Bolts on rear ramp break off frequently with normal use
    - Slat armor bends with continued ops . . . can cover escape hatches and block rear troop door in ramp
    - Slat armor interferes with driver’s vision
    - Slat armor difficult for other traffic to see at night . . . Safety hazard in urban environment
    - Slat Armor prohibits normal use of exterior storage racks
  - **Significantly impacts handling/performance in wet conditions**
    - Adds excessive strain on engine, drive shafts, differentials
  - **Impairs off-road ops, larger footprint**
- **Though not designed primarily for the urban fight (MOUT), Stryker is well-suited for it**
  - **Unlike M-1, Stryker is “ghostly” quiet . . . tactical advantage**
- **Stryker overall OIF performance significantly better than HUMVEE, BRADLEY or M-1 in this environment**